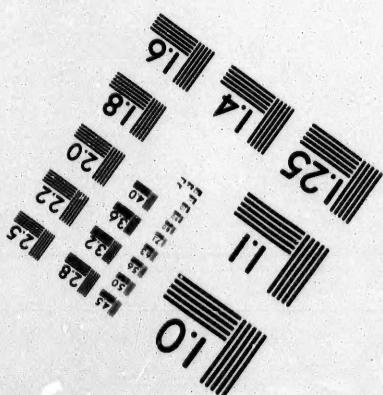
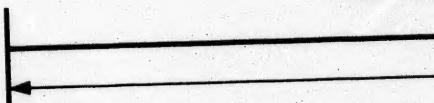


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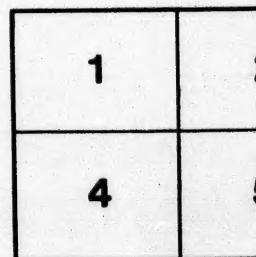
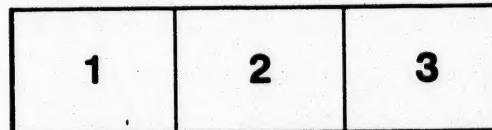
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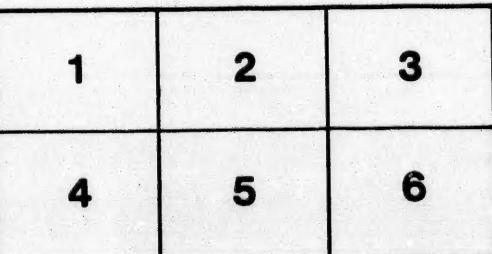
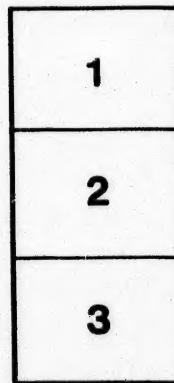
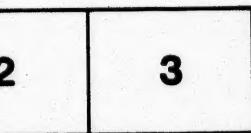
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**On the Significance of Bovine Tuberculosis and
Its Eradication and Prevention in Canada.**

By

J. GEORGE ADAM, M.A., M.D.

Professor of Pathology, McGill University, Montreal, and Pathologist to the
Agricultural Department, Dominion of Canada.

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ON THE SIGNIFICANCE OF BOVINE TUBERCULOSIS AND ITS ERADICATION AND PREVENTION IN CANADA.*

BY J. GEORGE ADAMI, M.A., M.D.,

Professor of Pathology, McGill University, Montreal, and Pathologist to the Agricultural Department, Dominion of Canada.

IN determining the significance of bovine tuberculosis so as to arrive at adequate conclusions—adequate, that is, from all points of view—three main questions have to be asked and answered. These are :

1. Is tuberculosis in cattle a source of danger to other cattle so as to seriously affect their well-being, and to be a source of loss to their owners ?
2. If infectious from animal to animal, is it infectious from animal to man, and thereby a grave source of danger to the human race ?
3. If infectious from animal to man, what are the commonest modes of infection, and, as a sequel to this, how are we to diminish the danger ?

If even the first of these only can be answered in the affirmative, then it becomes necessary to inquire how the disease can be arrested, and it is for our profession, as interesting itself in disease in general, to take a leading part in agitating for this arrest. If both the first and second, then are we not only indirectly but directly affected, and to allow tuberculosis in cattle to gain a headway without ourselves employing all the means in our power to arrest its progress, is little less than criminal.

To-day I propose briefly to consider in order, first, the significance of the disease, next its frequency in our country, and finally the steps necessary to stamp it out.

1. *Is tuberculosis in cattle a source of danger to other cattle ?*
To this the answer is an unqualified affirmative. We have abundant evidence here in Canada that the introduction of an infected bull, as again of infected cows, into a herd previously free from the disease, has been followed within a short time by symptoms of the disease in members of the old herd.

* Being a paper read at the meeting of the Canadian Medical Association, Toronto, August 28th 1890.

The ravages which this disease creates among the cattle of civilized communities is something appalling. Here in Canada, as I shall proceed to point out, we are in a relatively very favorable condition, and most of us in our profession see very little of the disease and of its results. It is otherwise in the Old World; there the steady spread of this plague among the dairy herds is creating widespread alarm. That it is extending there is no doubt. The following table of slaughter-house statistics, which I take from an article by Professor Conn, gives some idea of the rate of this spread:

BAVARIA.	
1877.....	1.62 per cent.
1888.....	2.7 "
1895.....	5 "

SAXONY.	
1888.....	4.90 "
1890.....	15.7 "
1895.....	27.48 "

BERLIN.	
1883.....	2.86 "
1885.....	2.10 "
1895.....	15.45 "

LEIPZIG.	
1888.....	11.1 "
1889.....	14.9 "
1890.....	22.3 "
1891.....	26.7 "
1895.....	33.3 "

It may be objected that this increase is only apparent, that the veterinarians and the officials at the slaughter-houses have of late years learnt to recognize the disease with increasing accuracy, a single tuberculous gland being now often detected, whereas it was passed over in earlier years. It may also be objected that other factors have to be taken into account, namely, the experience of the inspectors, the attitude of the inspectors towards the disease—a desire to find little resulting in little being found, and *vice versa*; that, further, the age of the animals slaughtered affects the results (tuberculosis being a disease showing itself especially in older cattle).* But all through the period indicated by the above table great attention has been paid to the subject by veterinarians; their eyes have been opened to the existence of the disease, and to methods of gross anatomical diagnosis in the carcase. At Leipzig more especially, as Conn points out, the inspection has been most

* According to Roekl (I quote from a report of Dr. Bryce to the Provincial Board of Health, Toronto), from a consideration of some 51,000 animals slaughtered in German abattoirs in 1888-89, according to the age of the animal the infection was found:

6 weeks old.....	0.6 per cent.
6 weeks to 1 year.....	0.6 "
1 to 3 years.....	11.4 "
3 to 6 years.....	33.1 "
Over 6 years.....	43.4 "

careful. It has been under the same management during the whole period, so that the results of successive years may more safely be compared with each other than in most cases, and Leipzig affords the strongest evidence of the increasing frequency of the disease.

This rise in percentage of tuberculous cattle seen in the slaughter-houses at Leipzig from 11.1 per cent. to 33.3 per cent. in seven years is veritably appalling, and no other explanation can be afforded than that the disease, in Germany at least, is spreading with terrible rapidity. So much indeed is this the case that competent authorities there are of opinion that in a few years there will be no breeding herds left unaffected. If, in place of the slaughter-house statistics, we take those afforded by the tuberculin test, the percentage of cases found in animals other than yearlings is yet higher than those afforded by the slaughter-houses. In Germany and Denmark veterinarians have come to the conclusion that the amount of tuberculosis is over 50 per cent. of all the animals in the land, many large farms being found without a single sound animal. In other words, about half the animals in northern and western Europe would seem to be afflicted with tuberculosis.

Corresponding statistics for Britain do not exist, nevertheless the conditions there, it would seem, are scarcely if at all more favorable. Thus in the County of Midlothian, abattoir statistics show the existence of the disease in 22 per cent. of the animals slaughtered, in Yorkshire a percentage of 22.8, Durham 18.7, and in London 25 per cent. These, be it remembered, are slaughter-house results and not those derived from the tuberculin test. In fact, tuberculosis among the most valuable and most highly bred herds is so extensive that extreme precautions should be taken and stringent contracts made by the buyer as well as stringent regulations framed and carried out by the Government to insure that, however great the cost of the individual cow or bull imported, the animal be found perfectly sound and unaffected by the disease before it is permitted to enter the country.

Personally, though in this I speak in no official capacity, I am inclined to think that, taking into consideration the fact that if once an animal has been inoculated with tuberculin it may not give a second reaction until more than a month has elapsed, I would urge that all cattle imported for breeding purposes be kept in quarantine for six weeks at least, and only permitted to be delivered to owners in this country if at the end of that period they fail to react. Otherwise, by any other course, there is a distinct danger that the disease may be introduced into herds previously quite free from the disease.

Nor even in the Eastern and older populated States of America is the condition much more satisfactory. Certainly, in Massachusetts, where the most painstaking observations have been made, the disease has been found very common. In their report for 1895, the Cattle Commissioners of that State show that in several large herds the percentage of animals reacting to tuberculin was as high as

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100 per cent. These are, it is true, extreme cases. Of 3,295 animals examined by inspectors and others in various parts of the State, 810, or about 24.53 per cent. reacted. Of neat cattle examined at the Stock Yards, about 6.21 per cent. were condemned, while in the district of Nantucket, selected because of its position as an island on the coast upon which there were comparatively few cattle, and these fairly well isolated, 6 of the 635 animals upon the island, or rather under 1 per cent. reacted to the test. This, while it shows considerable variation in the prevalence of the disease under varying conditions, shows also that it is far from infrequent, and that care must be taken with regard to importation of stock for breeding purposes, from the Eastern States as well as from across the sea.

What are the results of and what the dangers from this extraordinary prevalence of the disease elsewhere?

First and foremost, there is the effect upon the animal itself, upon its value as a milker, a breeder, and a meat-giver. While for some months a cow reacting to the tuberculin test may remain sleek and give abundant milk, sooner or later the disease progresses, she emaciates, dries up, becomes useless, and when killed is almost useless. What was once a valuable animal is finally a great loss to the farmer. I have met with cases of apparent healed or obsolescent tuberculosis in cattle, and it may be that such cases are not uncommon—in cattle, just as in man; but undoubtedly the danger is that the disease will extend.

In the second place, though this matter I shall not discuss at the present moment, there is the danger to the community in employing the milk and meat from such an animal. In any case where this disease is at all frequent, the loss to the farming community, and so to the country at large, is enormous.

Even in Scotland, which cannot be called a large country, or one in which cattle-raising and cattle-breeding is the staple occupation of the inhabitants, Professor Wright, in 1893, estimated that tuberculosis in cattle caused an annual loss of dairy stock of about £440,000, or \$2,000,000, and this apart, I take it, from considerations of loss in milk and butter, and loss as breeding animals.

We may therefore conclude that, purely from the standpoint of the agriculturist, it is all-important that this disease be if possible eradicated.

II. *If infectious from animal to animal, is bovine tuberculosis infectious from animal to man?* The answer to this question is generally given as an unhesitating affirmative. I wish, however, to point out to you to-day that while we must accept the affirmative as the correct answer, and while it is the duty of the individual and of the State to act in full accordance with the belief that this is so, the amount of reliable evidence of direct transmission of tuberculosis from cattle to man is singularly slight. For let us consider the means at our disposal for determining this point. Could

we make a direct experiment the determination would be easy and straightforward; but this is just what we cannot do. To inoculate the human being with tuberculous material, or expose him to infection from a diseased cow, would be a criminal act; it would differ in no sense from attempted murder. We can, it is true, perform the opposite experiment, that of inoculating cattle with phthisical sputa or other tuberculous material from man. If we do this, as Theobald Smith has pointed out, we discover the remarkable fact that cattle are relatively insusceptible, or are but slightly susceptible to human tuberculosis. Whereas tubercle bacilli obtained from cattle introduced into other cattle induce a relatively virulent disease, those obtained from man either set up mild chronic disturbance tending to be localized or lead but to transient results, what tubercles are formed undergoing absorption and disappearance. Our own observations in Montreal fully confirm Theobald Smith's statement. That, because for cattle bovine tubercle bacilli are very virulent, therefore they are also very virulent for man, more than are the human bacilli, we know from comparative bacteriology to be an absolutely unsound deduction. This may be so, but it may not. We have fairly abundant evidence that passage of pathogenetic germs through a series of animals of one species, leads to those germs attaining their maximum virulence for that species—but not by any means necessarily for other species. Indeed at times the virulence for other species is distinctly lessened by such passage, and in connection with tuberculosis we have distinct evidence that the bacilli obtained from fowls suffering from tuberculosis differ even more widely in properties from those obtained from man than do the bovine tubercle bacilli. Despite some earlier observations to the contrary, it is now generally found that fowls may, with impunity, be fed with human phthisical sputa without becoming infected. Kruse has, it is true, obtained in a few cases tubercle bacilli of the avian type from the human body, indicating that man may be infected from birds. But we cannot legitimately and by analogy apply these observations to the case of bovine tuberculosis and man. We are forced, therefore, to fall back upon evidence of another type.

Do the bacilli gained from the human and bovine species possess a morphological and cultural identity? They do not. The bovine grow more freely in the ordinary glycerinated media; they are, I find, of greater relative breadth, while again, as already indicated, pathogenetically they exhibit different degrees of virulence, and this when inoculated not only into cattle, but into guinea-pigs and the small animals of the laboratory. Koch, it is true, in his classical experiments held them to be identical, but later research has shown them to be so distinct as to make some observers consider them distinct species. But to classify them as distinct is to pass beyond what is right and reasonable. We are accumulating more and more facts to show that pathogenetic bacteria may undergo extensive modification according to the nature of their environment, and that within certain limits bacteria may show more or

less permanent variation of common properties as a result of variation in environment. And in this matter of tuberculosis we have the most important observations by Nocard and Roux that avian tubercle bacilli, which differ more widely from the human than do bovine, can be shown not to be a distinct species, but what may be termed a *race*:-

While under ordinary conditions, human tubercle bacilli inoculated into birds are destroyed, and lead to no organic changes, if a pure culture of such bacilli be placed in celloidin capsules, and those be then hermetically sealed and introduced into the abdominal cavities of birds, when thus protected from the body cells but fed by the body humors which diffuse through the celloidin, they will grow, and in the course of weeks assume all the characters and all the pathogenetic properties of the avian bacilli. We can only from this conclude that the races of the tubercle bacilli spring from a common stock, and have undergone material modifications according to their surroundings. So far, however, bacilli having all the morphological and cultural characteristics of the bovine "race," have not been isolated from the human organism, nor do I know that, so far, by placing protected human bacilli in the abdominal cavity of the cow, these have assumed the bovine characters. It is in this last experiment, I believe, that the solution of the question is to be found. For if we can show that under favorable conditions the human bacillus can become highly pathogenetic for cattle, the converse would also seem to hold that there are conditions under which bovine tubercle bacilli can be pathogenetic for man.

Failing direct experimental and bacteriological evidence of the absolute identity of bovine and human tuberculosis, we are for an answer to this question driven back yet further, and this time to casuistic evidence. Have we any evidence or absolute proof that by natural means tuberculosis has been conveyed from cattle to man? We generally teach that we have such positive proof, and at first thought it would seem easy to collect case after case in which, for example, butchers, and those dealing with tuberculous animals, have become infected through wounds, and so on; or again, of children and other human beings fed upon the infected milk of tuberculous cattle developing tuberculosis. But when we come to examine into these cases, we must be struck by the lack of indisputable evidence afforded. To prove the case we must be able to absolutely exclude every other possible mode of infection, and with human tuberculosis so common a disease, such exclusion is a matter of extreme difficulty. It must be shown that the individual has not come into contact with any other human being actively suffering from the disease. In the case of butchers it has to be proven that they have dealt with tuberculous cattle, and no other infected animals: previous cases of human tuberculosis in the neighborhood have also to be excluded, for we know that in dwelling-houses the virus may linger for long in the dust and in hangings of rooms. Thus, to obtain an uncomplicated case is a matter of the greatest difficulty.

Upon broad principles, it is true, the frequency of tuberculosis among children and its increasing frequency during the period when they have a diet largely of cow's milk, would appear to be a strong argument in favor of believing that the milk of cows affords the most likely source of infection. Only in this last week's *British Medical Journal*, in an able paper by G. F. Still of the Great Ormond Street Hospital for Children, the matter is brought forward very clearly. He considers a series of 769 consecutive necropsies on children under twelve years of age; in these no less than 269, or more than one-third of the total number of cases, showed tuberculous lesions. We find of these 269 cases, 117 or no less than 43 per cent. occurred at the milk-drinking period of life, namely during the first two years of life, and 56.5 per cent. occurred in the first three years. Undoubtedly the main incidence of tuberculosis in the young corresponds more or less exactly with the period in which milk forms, or should form, the chief article of diet, and as Still quotes from a report on tuberculosis, presented to the Council of the British Medical Association, "the mortality from tuberculosis in early childhood is not decreasing as it is at other ages in the United Kingdom, and the opinion that this great prevalence of the disease in childhood is due to infection through the alimentary canal by milk from tuberculous cows, appears to be well founded."

But now let us analyse Dr. Still's very careful studies upon the sequence of infection. To determine such sequence is a difficult matter, because tuberculosis in children so rapidly tends to become generalized, and it is difficult to make out which are the oldest and which the more recent lesions. But a study of the lymphatic glands affords material aid; thus, large cheesy or caseous masses in a mesenteric gland with scattered tubercles in the peribronchial glands indicates that the intestinal lesion is the older, and conversely, if the peribronchial glands be the more affected, infection has been more probably through the respiratory tract. Tubercular adenitis of the larynx and tubercular ear disease would also appear to be mainly due to infection through the air rather than the food. Thus of the 269 cases above referred to the channels of infection were as follows:

RESPIRATORY :

Lung.....	105	138	153 = 57.2 per cent.
Probably Lung.....	33		
Ear.....	9		
Probably Ear.....	6		

ALIMENTARY :

Intestine.....	53	63	63 = 23.4 per cent.
Probably Intestine.....	10		

OTHER CASES :

Bones or Joints.....	5
Fauces.....	2
Uncertain.....	48

It thus follows that respiratory rather than alimentary infection is the commoner in children in about the ratio of 57.2 to 23.4. While this is the case it must also be admitted that the proportion of cases of alimentary infection is relatively high, so high as to make it very probable that the staple food of children, namely, milk, does play a part in the spread of the disease.

When now we come to examine the individual cases there are some which it is very difficult to explain unless we assume that infection has been through the milk. But while admitting this we have to confess that with scarce an exception the evidence afforded is not absolutely exclusive of possibility of infection by other means.

Demme records a case of four infants in the Children's Hospital at Berne, issue of sound parents, without any tuberculous ancestry, who died of intestinal and mesenteric tuberculosis as the result of feeding on the unsterilized milks of tuberculous cows. These were the cases in which he was able to exclude the possibility of other causes for the disease and was satisfied that the milk alone was to blame.

The Cattle Commissioners of Massachusetts give reference to a case of an infant, son of a college mate of one of their body, a comparatively strong healthy child of twenty-one months, who, visiting a relation for a week, drank unsterilized milk of a cow which was soon after condemned and killed in a state of generalized tuberculosis; this child died three months later with mesenteric tuberculosis. Only distant relations had died of this disease and the child had seen but one of these and that for short intervals. A second child of the same family brought up on sterilized milk remained in robust health; the parents were free from the disease. Even in a case like this, convincing as it seems, more information is required with regard to the nurse and servants of the household, the possible existence of any case of tuberculosis in the house of the relation visited, and so on.

Ernst quotes similar cases. Olliver's well-known case, quoted in the *Semaine Medicale* of February 25th, 1892, is also not quite perfect. The case was that of a girl of apparently healthy parentage and previous surroundings, who died of meningeal tuberculosis. She was educated at a boarding school where thirteen pupils had been ill with, and then had died of, tuberculosis within a few months. The milk supplied to the school was from cows kept on the premises; these animals upon examination were found to have tubercular disease of the udders and to suffer from general tuberculosis. Here, for example, it might be urged that under school conditions one girl might easily convey the disease to the other. The swiftness, however, with which the disease affected simultaneously a large number of individuals, is on the whole, in favor of regarding the disease as having been brought about through the milk. Thus the evidence, while not absolutely convincing, is strongly in favor of the view that tuberculosis can be conveyed

through the milk of animals extensively diseased, and this being the case, we cannot sit with hands folded and regard the extension of bovine tuberculosis with indifference, but must make such regulations as will diminish the possibility of such infection.

3. *What are the more frequent modes of Infection?* Naturally apart from actual contact with the diseased animals and their products, the commonest modes of infection are by the animal products used as food, namely, the meat, milk and milk products. There are but a few words that I wish to say in this connection. The infectiousness of meat may be rapidly dismissed. Sims Woodhead and the British Royal Commission have shown that while the ordinary cooking of meat is sufficient to destroy tubercle bacilli, and while thus in English-speaking countries the danger of infection from this source is reduced to a minimum, it nevertheless may happen that the portion of a large joint in the centre may not be subjected to a temperature sufficient to kill the bacilli. At the same time the report from the same Royal Commission shows clearly that even in fairly well advanced cases of tuberculosis the bacilli are present but in small quantities in the meat itself; in fact, muscle is one of the last tissues to become the seat of the tubercular process. They show that the great danger is not from the existence of tubercles within the meat but of contamination of the surface in the process of dressing, by the knives and hands of the operators becoming smeared with material from other regions which are the seat of extensive disease.

When such susceptible animals as guinea-pigs, fed directly with the expressed juice of raw meat, do not thereby become infected, it is, to say the least, little likely that cooked or even partially cooked meat can set up infection in man. Where the disease is so far advanced that the meat may become dangerous to humanity there is little likelihood of such meat being exposed for sale or employed as a food.

With milk, the problem presents several difficulties. Accepting it as a fact that this can convey infection, the conditions under which it does so are, I think, not generally recognized. Thus the British Royal Commission lays it down that only when the udder is diseased does the milk become infectious, and would suggest that the withdrawal from the dairies of cows having any disease whatever of the udder, would form some approach to security against the serious danger incurred to man by the use of tuberculous milk; "but it would not be an adequate security." The report further states, "if the expert finds tubercle bacilli in the milk, the cow has dangerous tuberculosis of the udder; if he does not find them, he may apply a further test by inoculating some susceptible animals with the milk and thereby learning the nature of the udder disease. By this test he will rarely be misled."

In this conclusion the British Commission strongly supported Nocard's opinion upon this subject. But this view that the tubercle

bacilli only pass into the milk when there is disease of the udder, I feel convinced is founded upon imperfect knowledge. This conviction is based upon the results of observations conducted by Dr. C. F. Martin and myself for the Dominion Government during the course of last year.*

On ten cows placed at our disposal by the Minister of Agriculture necropsies were made, and we could not find a trace of a single tubercular focus in any one of the udders, and that notwithstanding very careful study and examination. Any part that upon section looked to us the least suspicious, was subjected to examination under the microscope. Yet in the milk of two of these cows we detected bacilli in fair numbers, in four others on certain occasions we saw forms which we were compelled to describe as undoubtedly bacilli, and what is more, two of the guinea-pigs inoculated with milk from the cow which showed the greatest number of bacilli, undoubtedly succumbed to tuberculosis. It is true that the majority of the animals inoculated with this same milk remained perfectly free from the disease, *i.e.*, of twenty-nine guinea-pigs and twenty-six rabbits inoculated intraperitoneally with varying quantities, only two guinea-pigs succumbed, while again a calf, fed solely with the milk from this cow, remained in perfect health although fed for five months. Had only this cow shown no sign of tuberculous disease of the udder we might have thought that our failure to recognize it was due to insufficient examination, but the same absence of udder disease was seen in the case of the other cows which afforded the bacilli.

Since publishing our report Rabinovitch and Kempner have contributed to the Congress of Tuberculosis at Berlin a paper in which, by inoculation into guinea-pigs, they came to a similar conclusion. Taking fifteen cows which had reacted to tuberculin, receiving the milk direct into sterilized glasses and inoculating guinea-pigs with a mixture of the precipitate and creamy layer after centrifugalization, they obtained the following results:

From ten of the animals (66.6 per cent.) they obtained a positive result, but of those animals only one showed clinically definite tuberculosis of the udder, and one other showed udder tuberculosis under the microscope. Of the remaining eight cases three were found at necropsy to present advanced generalized tuberculosis without tuberculosis of the udder, one showed slight tuberculosis, and the remaining four only presented either dubious or absent clinical signs of the disease. They thus come to the conclusion that tubercle bacilli can pass into the milk even in the early stage of tuberculosis in which there is no recognizable disease of the udder as also in cases in which the disease can only be detected by the tuberculin reaction.

It has been objected in results of this nature that the bacilli in these cases are not truly tubercle bacilli, but are contaminations of

the udder, age. This conducted by ent during of Agriculture of a single withstand- pon section examination e cows we n occasions undoubted ulated with of bacilli, that the k remained guinea-pigs th varying n a calf, fed rfect health own no sign hought that xamination, cas of the empner have a paper in similar con- tuberculin, inoculating creamy layer results : ined a pos- cally definite tuberculosis s three were tuberculosis erculosis, and present clinical that tubercle of tuberc- udder as also cted by the the bacilli in minations of

a relatively non-pathogenetic form. Thus, as has been pointed out recently, there may be present in milk a bacillus which microscopically is undistinguishable from the true tubercle bacillus, and which, when inoculated into guinea-pigs, produces a disease and frequently death with symptoms very similar to those of true tuberculosis. But to animals other than guinea-pigs, this bacillus is not harmful, and probably it has no effect on man. Only by fuller experimentation is it possible to distinguish between these two forms of organism, and it is urged that, recognizing the presence of this false bacillus in milk and butter, experiments such as those above described are open to serious question. Indeed, some go so far as to claim that nearly all the fatal results obtained from inoculating butter into guinea-pigs, have been due to this false bacillus and not to the true one.

Such a bacillus has been isolated from ordinary Timothy grass, and undoubtedly resembles very closely the tubercle bacillus, but herein comes the difficulty in accepting this explanation for our experiments and those of Rabinovitch. In our case the udders were carefully washed with creolin before milking, and whereas the milk was first passed through a sterilized funnel into sterilized bottles which we brought immediately to the laboratory, later the milk was received direct from the cleansed udder into the sterilized bottles. There was here practically no chance for contamination of the milk, unless indeed it be held that this false tubercle bacillus is a normal inhabitant of the larger milk ducts. Rabinovitch and Kempner took similar precautions. It is also interesting to note, in the second place, that we found a relationship between the number of bacilli present in the milk and the extent of the tuberculous process in the animals. The two animals in whose milk we found the bacilli most extensively present were those showing most extensive disease of the lungs. Such a relationship would be impossible were we dealing with contamination. Thus I can only fall back upon the belief, that just as I have recently shown that the gland cells of the liver and of the kidney take up and discharge the colon bacilli, so the cells of the actively working milk gland in cattle have a similar power; and just as I find that the colon bacilli tend to be attenuated in their passage, so would I ascribe the somewhat altered appearance of these tubercle bacilli in milk of animals not suffering from udder tuberculosis to direct action upon them in the process of excretion, and would recognize that their lowered infective powers are due to the same result. At the present moment at the Experimental Station at Outremont, Dr. Higgins and I are putting this view to the test.

For myself, therefore, I cannot but come to the somewhat unsatisfactory conclusion, that whereas, in the first place, the milk of animals not suffering from udder tuberculosis may contain bacilli, nevertheless such milk is not of high infective power, and that, therefore, the frequency with which the bacteriologist may by inoculation into the very susceptible guinea-pig find the milk to

be infectious, it is not absolute indication of its danger when employed as a food for man. Only when there is recognizable udder tuberculosis and active tubercle bacilli are discharged into the milk in enormous numbers in consequence of ulcerative changes occurring in the tubercles, is there real danger. For practical purposes, therefore, I agree with Nocard, that as regards the milk-supply local tuberculosis of the udder is what has to be most especially guarded against, and this, not because the evidence at our disposal affords absolute proof of the transmission of tuberculosis from cattle to man, but because the trend of the evidence is all in that direction.

ON THE EXTENT OF TUBERCULOSIS IN CANADIAN CATTLE.

So far as I can see there is no large tract of country in the North Temperate Zone in which cattle are so free from tuberculosis as are our Canadian cattle, unless it be the Western States. During 1898 the testing of cattle was encouraged to the utmost possible degree by the Government, and as is natural, the applications for inspection came more especially from those districts in one or other part of the Dominion where they had reason to fear the existence of the disease. In these "suspect" districts and "suspect" herds over ten thousand head of cattle were inoculated, and of these only 5 per cent reacted. Further, of ninety thousand cattle inspected at Montreal during 1894 on the eve of embarkation, at a time when, in consequence of the active measures taken by the British Government against importation of Canadian cattle on account of suspected pleuro-pneumonia—a disease which I may add is absolutely non-existent here—at a period, that is, when great care was being taken not to export animals showing any infectious disease, only eighty animals were rejected by the inspectors, and of these eighty two were recognized as suffering from tuberculosis and even in them this was local. I do not mention these last figures as giving an absolute indication of the incidence of tuberculosis in Canadian cattle, but this I do say, that no other civilised country could now-a-days ship ninety thousand cattle under like conditions and have only two of the number rejected for clinically recognisable tuberculosis.

Similarly that same year the lungs of 2,504 animals were examined in the abattoirs of Montreal, St. John, N.B., and Halifax, N.S., and among these there were only fourteen cases of tuberculosis or a percentage of 0.6. There is, I say, no other country which can show such low figures. One reason for this is that for now some years great care has been exercised in insuring that animals imported for breeding purposes are absolutely healthy. Another is that the keeping of animals within town limits, cooped up in dairies, is almost unknown, and yet another reason is that our animals in general have abundant pasturage and roam over wide areas; during the greater part of the year they live in most healthful conditions.

Were any other indication needed with regard to the rarity of tuberculosis in our cattle, it is to be found in the following fact. For purposes of investigation of the Experimental Farm at Outremont, in order that Dr. Higgins and I could compare the infectiousness of milk from animals with advanced disease of the udder, as compared with that from diseased animals not showing such udder trouble, it is absolutely necessary that we should obtain one or two cows showing udder disease. This most important portion of our investigations is at a standstill, merely because we cannot obtain such animals. We have only heard of one small collection of cases, which we could not utilize, as a matter of principle, because the owner, hearing that they were necessary to us, immediately demanded a ridiculous price. But Dr. McEachran, the Chief Inspector, with the authority of the Minister, has sent detailed orders to all the inspectors over a large area of country, asking them to look out for and report any such advanced cases. That was some months ago, and still we are waiting to obtain these cattle.

PREVENTION OF TUBERCULOSIS.

The rareness of tuberculosis among our cattle makes it possible to hope for a complete eradication of the disease. In the Old World, where the disease is so common, such eradication appears chimerical—not only so, but is absolutely impracticable; and there to begin a crusade of extermination and to slaughter every animal giving the tuberculin reaction would ruin the farmers—and would also ruin the Governments. To slaughter only animals showing clinical symptoms would be but a sop in the pan; it would certainly not extinguish the danger of contagion and the slow spread of the disease. To restrict the movements of animals reacting to tuberculin would mean placing the whole country under the ban, and would absolutely paralyse the cattle industry; while again, to compensate the farmers for the condemned animals would be found the cause of great dissatisfaction. The disease is so lingering and the eventual emaciation so marked that it is very difficult to arrive at any conclusion as to what was the original value of the animal. The most that can be done there is to introduce what is known as Bang's system, namely, that of separating the healthy from the diseased animals in separate byres, keeping them apart, and gradually, as the diseased animals die off, replacing them in the sound herd by animals which do not react, and also by adding to this sound herd the calves born to the diseased stock, it having been found that such calves, removed immediately from their mothers, show almost without exception no sign and no tendency towards the disease.

Now, on the other hand, returning to Canada, the disease is so rare that Dr. McEachran calculates that probably throughout the Dominion but 10,000 animals show clinical symptoms, and this is probably an excessive estimate. Were there 10,000, and were these to be slaughtered, even at full value compensation would not exceed \$250,000. Those reacting to tuberculin would be, of course, more

numerous, but of these 70 per cent. at least, if not a much higher percentage, could be fed and slaughtered for beef under supervision, while in the case of highly bred cattle reacting to tuberculin, in which no clinical symptoms are discoverable, they could be kept in isolated buildings and treated and bred from under Bang's system.

I cannot but cordially endorse Professor McEachran's opinion that by the expenditure of an amount of money, trifling in itself, as compared with the enormous benefits that would accrue both to the live stock industry and to the people of Canada, the disease could be practically eradicated in the course of three or four years.

Leaving out of account the hygienic importance of such eradication, "45 per cent. of the population of Canada is engaged in rural pursuits; the railways depend upon agriculture for one-fourth of the freight they carry, and the canals one-third. As regards the shipping industry, more than half of the total exports are agricultural products, the value of which for 1897 amounted, according to the Year Book, to the sum of \$44,533,592. . . Surely no reasonable expenditure," to quote Dr. McEachran, "can be withheld to eradicate a disease that interferes with the development of an industry of such importance to the country's prosperity." And when, in addition to this, we regard also possible danger to the health of humanity, surely it is our duty, as medical men, to support strongly any attempt on the part of the Government to bring about the prevention of this disease in cattle.

I am most anxious that it be understood that I speak as a private individual, but at the same time as one who has for the last two years continually studied the subject in its various aspects. If it seems overbold and too large a project to introduce this attempt to eradicate the disease simultaneously over the whole Dominion, *at least, it seems to me, that the endeavor might be started in well-defined areas, Prince Edward Island, for example, Cape Breton, or Nova Scotia.* And if what I have stated be correct—and our observations in Montreal entirely confirm those of Professor Theobald Smith—if cattle show but a transient and slight, and not an ulcerous and infective disturbance when inoculated with what are truly enormous numbers of tubercle bacilli obtained from man; if cattle thus are relatively insusceptible to the human disease; then the disease may be either eradicated or kept absolutely in check even although tuberculosis continue to prevail among the inhabitants of the districts mentioned, without adequate endeavors to arrest its spread among them.

A corps of inspectors might be empowered to make a complete and perfect visitation, to kill off and compensate for all animals showing clinical evidence of the disease; to isolate or buy at full value, and place on Government reserves all animals reacting to tuberculin, according to the condition of their owners and their capacity or incapacity to undertake this work for themselves; to disinfect all byres in which infected animals have been discovered; to prevent

temporarily the entrance of animals into the areas visited after undergoing tuberculin test, and thereby to demonstrate whether these areas can be rendered absolutely exempt from bovine tuberculosis.

I believe that this can be done, and done at a cost relatively so small as to be incommensurate with the accruing benefit. *For if we in Canada can establish herds absolutely free from the disease, this means that in a very few years Canada will become the great centre for the breeding of high-class cattle, and European countries will have to come to us to re-establish their herds.* They cannot do it at home. We only, and only we, are in a position to make a fruitful endeavor to get rid of the disease in the course of three or four years. Possibly this statement is too sweeping, for there is a similar relative freedom from tuberculosis in the Western States, and by strict quarantine and rigorous inspection and regulations preventive of the entrance of untested animals, certain of those States might free themselves from this disease at a relatively small cost. But none of the States has the same favorable geographical position for testing the matter as we possess in our large islands and peninsulas—Prince Edward Island, Cape Breton and Nova Scotia. The absence of natural boundaries must necessitate extreme care in the individual States as at any time the disease might reassert itself. In any case it is for Canada to make the endeavor.

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